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U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF ORNITHOLOGY AND MAMMALOGY

REPORT

ON THE

INSECT FOOD OF THE CROW

BY

E. A. SCHWARZ

Assistant, Division of Entomology

[Reprinted from Bulletin No. 6]



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GOVERNMENT PRINTING OFFICE
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The examination of the contents of about 600 stomachs of Crows¹ submitted by Dr. C. Hart Merriam to the division of entomology was

¹ The insect contents of 801 Crow stomachs were submitted to Professor Riley for examination, but in several cases where many stomachs were collected on the same day and at the same place, under precisely similar circumstances, it was not thought necessary that all should be examined critically. In such cases half or more were thoroughly examined and the results tabulated, while the remainder were passed over with a simple inspection.—W. B. B.

intrusted to me by Dr. C. V. Riley, then United States Entomologist. Owing to the large bulk represented by the majority of the stomach contents, and more especially to the comminuted condition of the insect remains, the work of examining and determining was much more tedious and progressed much slower than was anticipated. In the often times difficult determination of minute fragments I have been greatly assisted by the other members of the division of entomology, and more especially by Messrs. William H. Ashmead and Theo. Pergande.

A detailed list of the contents of each stomach has been prepared, enumerating systematically the various species of insects found and giving the number of specimens. This list forms the basis of the following generalizations regarding the food habits of *Corvus americanus*, so far as the insects are concerned:

1. The insect food of Crows is almost exclusively composed of terrestrial species, i. e., such as are found on the surface of the ground, or hide during the daytime at the base of plants or under the various objects lying on the surface; or such as live in the dung of domestic animals, in decaying vegetable and animal matter, or underground.

There is not the slightest indication that Crows catch any insects while on the wing, and the almost complete absence of the numerous arboreal insects of all orders, i. e., such insects as are to be found on, or which live on the trunks, limbs, or leaves of trees and shrubs, indicates that the birds when sitting or resting on trees do not pick up insects.

The almost constant presence of coprophagous insects in the stomachs indicates that Crows preferably frequent dry pasture lands, dry meadows, or very open woods, where cattle or horses are grazing. In many instances the presence of certain species of *Chlanius*, water beetles, or an occasional aquatic Hemipter or a *Gryllotalpa* or *Corydalus*, etc., shows that the birds frequent the margins of ponds or streams, while in a number of other instances the presence of the larvæ of *Lachnosterna*, *Elateridæ*, etc., proves that the Crows have followed the plow of the farmer. Many of the terrestrial insects eaten by Crows abound during the warmer season in cultivated fields, more especially in corn and clover fields, and have no doubt been picked up by the birds in such localities.

2. The insect food of the Crow consists only of large or medium-sized insects; small species are only rarely, if ever, picked up. The smallest insects found are certain species of *Aphodius*. Ants form a marked exception to this rule, as small, or very small, species are frequently found in many stomachs.

3. The Crow appears to prefer insects with a hard covering to the more soft-bodied ones. Thus the number of the hard imagos of *Carabidæ*, *Elateridæ*, *Scarabæidæ*, *Curculionidæ*, and *Acridiidæ* enormously exceeds that of the Coleopterous, Lepidopterous, and Dipterous larvæ found in the stomachs, and no soft-bodied imagos (a few *Diptera* excepted) seem to be eaten. In many instances, however, this pecu-

liarity may be explained by the fact that the larvæ, as a rule, live in more hidden situations and are more difficult to find than the imagos. But Crows derive a great deal of their food from the insects living in dung heaps and dead animals where Dipterous and other larvæ abound; still these are but rarely met with in the stomachs. A marked exception to this rule is the frequent occurrence of spiders, and more especially species of the family Lycosidæ, or ground spiders.

4. It would seem that Crows have a predilection for insects possessing a pungent or otherwise strong taste or odor. This is exemplified by the prevalence of Carabidæ (among them the often recurring genus *Chlanius*, possessing a peculiar odor), coprophilous or necrophagous Coleoptera (Silphidæ, Histeridæ, and Scarabæidæ Laparosticti), ants, and more especially by the almost constant occurrence of certain species of the Heteropterous family Pentatomidæ.

5. Finally, as a peculiarity of very little importance, may be mentioned the fact that insects of a bright, and more especially golden, color are apparently very attractive to Crows and are eagerly picked up by them. Thus *Calosoma calidum*, with its bright golden elytral spots, is met with in a large number of stomachs from various localities.¹ Very often only little elytral fragments of this species are found which would seem to indicate that the birds even pick up the elytra of dead beetles. Another striking illustration is furnished by the frequent occurrence of *Euphoria fulgida*, with its peculiar golden-green color. Other examples are the Cicindelidæ, *Pterostichus sayi*, *Geotrypes splendidus*, *Phanæus carnifex*, and others.

If we now proceed to a consideration of the insects eaten by the Crow it is at once evident that a mere list of them, comprising as it does several hundred species, is only bewildering and misleading. If all the numerous species which occur only once or at best in a small number of stomachs and in limited numbers are eliminated, and only those species are taken into consideration which occur in a large number of stomachs and most of which are represented by a very large number of specimens; finally, if we divide the latter class of insects into several convenient groups, each defined by similarity in food habits, we arrive at a certain number of clearly established and characteristic features in the food habits of the American Crow. The writer confidently asserts that, while an examination of several hundred additional stomachs would no doubt greatly increase the list of insects eaten by Crows, it would not alter, in the least, nor materially add to, the characteristic features now arrived at.

It is possible that in the extreme Southern States, as well as in the far West, some other features in the food of the Crow would appear

¹No traces of our common and bright-colored *Calosoma scrutator* and *C. wilcoxi* have been found in the stomachs, but this is easily explained from the habits of these species which live in the woods and are more or less arboreal, whereas *C. calidum* is strictly terrestrial and frequents pastures and fields.

besides those enumerated below; for only a single stomach from Florida and one from Oregon were among those submitted for examination. There were also only a few stomachs from Kansas¹ and Nebraska. Since all the other stomachs were collected at various places in the region extending from Virginia to Maine, and west to Iowa and Wisconsin, we should expect that the difference in the faunal regions would produce a corresponding difference in the food supply of the Crow. But these differences are of slight importance, and with a single exception the main features of the food of this bird remain wonderfully uniform throughout this whole region.

The following groups of insects representing the principal food supply of the Crow are arranged according to their relative importance, but this sequence might undergo some changes if an equal number of stomachs from all parts of the country were available for examination. Of the stomachs submitted, those from Virginia, the District of Columbia, and Maryland greatly outnumber those from all other localities combined.

1. *Grasshoppers* (Acridiidae).—During the months of May and June, i. e., during the May-beetle (*Lachnosterna*) season, grasshoppers, mostly of the genus *Tettix*, occur in the vast majority of stomachs, but with few exceptions in moderate numbers only. With the disappearance of the May beetles (toward the end of June) specimens of the typical locusts (grasshoppers—*Melanoplus* and allied genera) increase in number until in the month of August and throughout the fall they constitute by far the greatest part of the insect food, often occurring in astonishing numbers, and often forming the only insect food. Grasshoppers are also largely picked up in winter, evidently on warm days and when there is no snow on the ground.

2. *Dung beetles*.—Under this heading the following Coleoptera are comprised: Species of *Silpha* and *Hister*, the Scarabæid genera *Copris*, *Onthophagus*, *Aphodius*, and allied genera. Certain species of *Staphylinus* are also included here, which, although insectivorous, confine their operations to the droppings of domestic animals. Dung-inhabiting dipterous larvæ or their pupæ were, however, met with in only a few stomachs, and the same may be said of the larvæ of dung beetles. A larger or smaller number of these dung beetles, and more especially of the Scarabæid genera just mentioned, or at least single specimens thereof, occur in most of the stomachs from all localities and throughout the whole year, and in many instances comprise the greater bulk of the insect food.

3. *Ground beetles* (Carabidae).—These occur likewise in the vast majority of stomachs from all localities and throughout the year, and the list of the species thus found is a very extended one. The genera most frequently present are: *Calosoma*, *Carabus*, *Chlaenius*, *Pterostichus*, *Harpa-*

¹ Since this was written 21 additional stomachs from Kansas have been examined by Mr. Schwarz, but without essentially modifying his conclusions.—W. B. B.

lus, and *Anisodactylus*. It will be noted, however, that none of the species are ever represented by any considerable number of specimens in a single stomach. Thus the bulk represented by the Carabidæ is much inferior to that of the grasshoppers and May beetles, and probably also smaller than that of the dung beetles. Carabidous larvæ were found only in two or three isolated instances.

4. *May beetles (Lachnosterna)*.—During a short period of the year, commencing, in the latitude of Washington, D. C., at the end of April, and in Maine and Michigan about a fortnight later, and extending toward the end of June, these beetles furnish, as regards bulk, number of specimens, and frequency of occurrence, the principal insect food of the Crow. In fact, there are only a few stomachs during this season that do not contain traces of Lachnosternas, while frequently large numbers of specimens are found in a single stomach, and this often to the exclusion of other insect food. This habit prevails throughout the whole region¹ and would occupy the foremost rank in this enumeration but for the fact that it is restricted to two months of the year.

The fact that the Lachnosterna season coincides with the breeding period of the Crow deserves to be emphasized, and the principal, but by no means exclusive, insect food of the nestlings may thus be said to consist of these Lachnosternas.

Lachnosternas are above ground only at night, when they feed on the foliage of trees and shrubs; they hide during the day underground. In determining the economic status of the Crow as an insectivorous bird it would seem to be of some importance to ascertain how and where the birds find these beetles. It may be that only those are eaten which during their nocturnal flight had been half eaten by bats and other nocturnal enemies of Lachnosterna or which had been otherwise disabled; or it may be that only those specimens are eaten which have fallen into lakes or streams during the night and which are then washed ashore in a drowned or half-drowned condition; finally it may be that the Crows are able to discover and to dig out the beetles during the day from their subterranean retreats. No direct observations on these points seem to have been made, but I have no hesitation in accepting the latter alternative, for the reason that it is an undeniable fact that the Crows find an enormous number of other insects that hide during the day under sticks, clods of earth, and other objects (e. g., many of the Carabidæ), or in the ground at the base of plants (e. g., the Curculionidæ presently to be mentioned). Many of the coprophagous insects, and more especially the genera *Copris* and *Geotrypes*, are evidently dug out from their holes beneath cattle and horse dung. This, of course, does not entirely exclude the other alternatives, and, in fact, the often recurring presence of small ants in the stomachs seems to indicate that the Crows also pick up dead or wounded Lachnosternas which are frequently covered with ants.

¹ Even the single stomach from Kansas, collected in May (No. 15249), contains nothing except a number of Lachnosternas.

Larvæ of *Lachnosterna* (white grubs) were, contrary to expectation, met with in a comparatively small number of stomachs (about 20 in all, including a few where determination is doubtful), all of which were collected in the District of Columbia and adjacent parts of Maryland during the months of April and May. If a larger number of stomachs from other localities could have been examined it is possible that white grubs would play a more important rôle in the food habits of the Crow. The absence of *Lachnosterna* larvæ in all stomachs collected during the fall plowing season is easily explained by the great abundance of grasshoppers at this season. The few Scarabæid larvæ found in stomachs collected in the fall all belong to coprophagous species.

5. *Ground spiders* (Lycosidæ).—The only soft-bodied insects that occur in a very large number of stomachs from all localities and throughout the warmer seasons are various species of Lycosid spiders, which are so commonly met with on the ground in pastures and near water. The larger female specimens, carrying their egg sacs, appear more especially to form an attractive morsel to the Crows. The spiders are often represented in considerable numbers in the stomachs, occasionally forming the greater bulk of the insect food. Spiders of other families were but rarely met with in the stomachs, and never in large numbers.

6. *Weevils* (Rhynchophora).—Two species of weevils, *Epicærus imbricatus* and *Phytonomus punctatus*, both often referred to in economic entomology, occur abundantly in a large number of stomachs. They would play a very prominent rôle in the food supply of the Crow but for the fact that this habit is locally restricted on account of the distribution of the two species. *Epicærus imbricatus* does not extend into the Northern and Northwestern States, and the clover weevil (*Phytonomus punctatus*) is a comparatively recent importation from Europe, occurring from New York to Virginia and gradually spreading into the Northwestern States.¹ Both species are terrestrial during the day and hide in the ground at the base of plants. Other weevils possessing similar habits are not infrequently found in the stomachs, more especially various species of *Sphenophorus* (bill bugs, of economic importance), and in less numbers *Tanymecus confertus*, species of *Sitones*, *Macrops*, etc. Various other nonterrestrial weevils occur only occasionally, the most abundant among them being *Lixus concavus*.

7. *Cutworms* (larvæ of Noctuidæ).—Considering the enormous number of cutworms that occur, especially in the spring and the earlier part of summer, in pastures, dry meadows, and open fields, and considering further that cutworms hide during the day at the base of plants, under leaves, sticks, clods of soil, etc., in short, in just such places as are preferably investigated by Crows in search of food, it is remarkable that

¹ It was never noted in Michigan prior to 1892, and it is interesting to find that there is a specimen in one of the stomachs (No. 15884) from that State, collected on May 8, 1892.

they do not constitute the largest portion of the insect food. Even if we include all other lepidopterous larvæ and pupæ found in the stomachs, this food does not by any means rank among the most prominent features. The only explanation of this fact that occurs to me has been mentioned before, viz, that the Crows greatly prefer insects with hard bodies. Still, the bulk represented by the Lepidopterous food is by no means an inconsiderable one, and the largest part is made up of Noctuid larvæ, or cutworms. These occur in many stomachs, usually singly or in very small numbers, rarely forming the bulk of the food in any one stomach and never the entire food. Noctuid pupæ were found only in isolated cases. Larvæ of the Pyralid genus *Crambus*, which live in silken tubes at the base of grasses, clover, etc., belong to the family next best represented in number of specimens, and occur in large numbers in a few stomachs. Bombycid larvæ, and especially Bombycid cocoons, come next, represented usually by single specimens. The rest of the Lepidopterous families are represented only by isolated specimens. Single imagos of Lepidoptera were found in only a few instances, and most of these are evidently specimens which had not yet issued from the chrysalis.

8. *Soldier bugs* (Pentatomidæ).—Although by no means representing a considerable portion of the insect food, the constantly recurring presence of various species of soldier bugs constitutes a characteristic feature in the food habits of the Crow. There are many species representing various families of true bugs (Heteroptera) that occur commonly on or near the ground, but, with the exception of these soldier bugs, only a few isolated specimens of a few species were found in all the stomachs. It seems probable that the strong odor or taste of these soldier bugs is the reason why they are so eagerly sought by Crows. The condition in which the specimens are found in the stomachs is also peculiar; for while the Crows generally have the habit of crushing and breaking into fragments all the hard insects they eat, these soldier bugs are almost always broken up in extremely minute particles which in the well-filled stomachs are often liable to be overlooked. Owing to this condition the exact determination of the species, as well as the determination of the number of specimens, is impossible in most cases. The soldier bugs thus found belong to *Podisus*, *Euschistus*, and allied genera.

9. *Ants* (Formicidæ).—As in the case of the soldier bugs, ants form only a small proportion of the bulk of the insect food, but their frequent occurrence in the stomachs suggests the explanation that they are relished by the Crows on account of their peculiar acid taste. Quite a number of species of various genera are represented, the largest species, *Camponotus pennsylvanicus* and various species of *Formica*, being most frequent. The presence of very small species of ants is, in many instances, probably due to accident, as has been mentioned on page 61.

The following enumeration of insects, arranged according to orders, comprises those which occurred only in a moderately large number of stomachs and usually only as single specimens, or only in a few stomachs in large numbers. Some of the insects of this class have already been mentioned.

Click beetles (Elateridæ).—A tolerably large number of species were found, but none of them represented by any considerable number of specimens. The most abundant of these species are *Limonius plebejus*, *Corymbites cylindriformis*, *Agriotes mancus*. Elaterid larvæ (wire-worms) were found only in a few isolated instances.

Lamellicorn beetles.—Lucanid beetles (*Lucanus*, *Passalus*) occur occasionally, while various species of the Scarabæid genera, *Serica*, *Hoplia*, *Anomala*, *Aphonus*, *Euphoria*, and others, form in the aggregate a not inconspicuous portion of the insect food. The prevalence of *Euphoria fulgida*, or at least of little fragments thereof, in quite a number of stomachs has been already alluded to.

Tenebrionidæ.—Some specimens of the genus *Eleodes*, found in the few stomachs from Nebraska and Kansas, lead to the supposition that if a larger number of stomachs from that region could be examined specimens of this and allied genera would be found well represented. These beetles, so characteristic to the fauna of the arid region of the West, fulfill most of the requirements of insect food preferred by the Crows; they are terrestrial, large, hard, and possess a strong, offensive odor.

Ants, Bees, and Wasps (Hymenoptera).—Besides Formicids only a very moderate number of species and specimens were found, most of them belonging to the fossorial families Crabonidæ and Eumenidæ (genus *Odynerus*). Quite a number of *Polistes* also occur in various stomachs.

Flies (Diptera).—The whole order is comparatively poorly represented, and only the following families deserve mention:

Crane flies (Tipulidæ).—These are much less frequently found than one would expect from their great abundance on meadow land. Still, eggs, larvæ, and much more rarely pupæ and imagos occurred in a moderate number of stomachs. In a few instances eggs were found without any trace of the imago.

March flies (Bibionidæ).—Larvæ of this family were found only in a few stomachs, but in very large numbers. They live gregariously under decaying vegetable substances.

Muscidæ.—The small number of the various larvæ and puparia, all presumably belonging to coprophagous or necrophagous species, found in the stomachs is in striking contrast with their enormous abundance in the excrement of horses, cattle, etc., or in dead animals. Imagos of these Diptera were found only in exceptional instances.

Crickets (Gryllidæ).—Excepting the Acridiidæ, the whole order of Orthoptera is very poorly represented; the only other representatives which occur in a moderate number of stomachs are ground crickets of the genera *Gryllus* and *Nemobius*.

The orders hitherto omitted, viz, the Homoptera and Neuroptera (in the old sense), are so poorly represented as to deserve no special mention. The same may be said of the order Myriapoda, of which a few specimens of a *Julus* were found.

In order to complete this picture of the food habits of the Crow, it is important to mention briefly those families, or even single species, of insects which are of economic importance, being either injurious or beneficial, but which were not found in the stomachs examined. Only such insects are mentioned here as occur on or near the ground and of which one might expect that the Crows, at least occasionally, would pick up specimens. Some of the orders or families unrepresented; or but poorly represented, have been mentioned before and are not here repeated.

Among the Coleoptera the absence of the useful ladybirds (Coccinellidæ) deserves special mention (only a single elytron of one species has been found). Still more striking is the absence of the large family of leaf beetles (Chrysomelidæ), including the notorious Colorado potato beetle (*Doryphora 10-lineata*). In fact, only four species of Chrysomelidæ were found in all the stomachs (two elytra of *Paria canella*, one elytron of *Colaspis brunnea*, and a few specimens of the aquatic *Donacia flavipes*). Chrysomelid larvæ are entirely absent. Finally, the soldier beetles of the genera *Chauliognathus* and *Telephorus* in the family Lampyridæ are not represented, and only two larvæ of a *Telephorus* were found in a single stomach.

In the Hymenoptera no injurious (phytophagic) families are represented, but, on the other hand, the immense host of beneficial (parasitic) species is also almost entirely absent, only a few isolated specimens having been found. The Crow is not one of the destroyers of the honeybee, for only a single bee occurred in all the stomachs.

In the Lepidoptera, which practically do not contain any beneficial species, the absence of all cabbage worms (larvæ of *Pieris rapa*, *Plusia brassica*, etc.), excepting a solitary specimen, deserves mention; also the absence of the various Sphingid larvæ and their pupæ, which infest potatoes, sweet potatoes, and tobacco. The corn worm (larva of *Heliothis armigera*) is here especially mentioned because it is said that the Crows pull out and injure the ears of corn only for the purpose of getting at the corn worms. This species has not been recognized, but it is possible that a few specimens are among the unidentifiable Noctuid larvæ.

In the Diptera the most injurious species is the Hessian fly (*Cecidomyia destructor*), but the small size of the larva and pupa, as well as their mode of occurrence, make it improbable that the Crows ever feed upon this insect, and no traces of them were found in the stomachs. The beneficial Diptera, viz, larvæ of Syrphidæ and the family Tachinidæ, are absent.

The complete, or almost complete, absence of the injurious Heteroptera forms a very striking feature. In all the stomachs examined only a single specimen of the notorious chinch bug (*Blissus leucopterus*) was found, and, unless we assume that this insect is too small, no explanation is offered why the Crow does not feed extensively upon the chinch bug, which possesses a strong odor and is more or less terrestrial in its habits. Excepting the Soldier bugs (Pentatomidæ), the insectivorous species of Heteroptera are hardly represented; the Phymatidæ are entirely absent (no doubt on account of their nonterrestrial mode of life), and of the Reduviidæ only a few specimens of a terrestrial species were found.

In the Homoptera the stomachs submitted for examination offered no opportunity for ascertaining whether or not the Crow feeds extensively upon the periodical cicada, but from the fact that in a small number of stomachs pupæ and imagos of another species of cicada were found, as well as from previous records and observations, there can be no doubt that this insect is not refused. The more or less injurious leaf hoppers (families Jassidæ, Cercopidæ, Fulgoridæ, Membracidæ), many species of which are frequently found on or at least near the ground, are not represented in the stomachs (excepting a single larva of a Fulgorid).

The only beneficial (insectivorous) family among the Orthoptera, viz, the Mantidæ, is represented in our fauna by only a few species, and none have been found in the stomachs.

No specimens of white ants (Termitidæ), the only injurious family of the old order Neuroptera, occurred in the stomachs, while of the eminently beneficial families only a single specimen of a mosquito hawk (*Æschnidæ*) and a single specimen of a lacewing fly (*Hemerobidæ*) were found.

All the families of spiders are insectivorous, but only a few are really useful to man, e. g., the Thomisidæ and the orb-weavers (*Orbitelariæ*). These are almost entirely absent, and the only family which is well represented (the Lycosidæ) has no economic importance.

No ticks (*Ixodidæ*) were found in the stomachs.

The insectivorous myriapods are not represented, being probably protected by their mode of life.

It will be seen from the foregoing remarks that among the principal insect food of the Crow there are only two classes of eminently beneficial insects, viz, the ground beetles (*Carabidæ*) and the soldier bugs (predaceous *Pentatomidæ*). The ground spiders (*Lycosidæ*) and the ants are, in the opinion of the writer, to be classed among the neutral or innoxious insects, which class also includes the dung insects, many of the lamellicorn beetles, and a great many of the other insects found in smaller numbers in the stomachs. All the rest belong to the injurious insects, notably the grasshoppers, May beetles (including some allied genera), the click beetles (*Elateridæ*), the weevils (*Rhyncho-*

phorous Coleoptera), the cutworms (in fact all Lepidoptera), and the crane flies (Tipulidæ).

It is evident that the percentage of the three groups of insects forming the chief insect food of the Crow can not be determined from the number of species nor from the bulk represented by the aggregate of each species, but must be determined by the number of specimens. It is difficult to give exact figures on this last point for two reasons, viz:

1. While it is easy to determine the number of specimens of a given species where there are but few in the stomach, it is often impossible to do so where the number is great and the specimens are in the decomposed condition in which insects are usually found when in such numbers. In most instances the number could only be approximated by the number of heads or mandibles, as the remainder of the body has been essentially destroyed by digestion.

2. A large proportion of the stomachs submitted are those of nestlings, and it follows that the mere fragment of any given insect is counted in such a case as a specimen, while it is probable that a single specimen may have been given in fragments or portions by the parent to several of the nestlings, so that combined they represent but one single individual. Nevertheless the difficulties do not, in my judgment, invalidate the general conclusions arrived at, which are, that the sum total of specimens of those insects which are emphatically injurious to agriculture vastly outnumbers those which may be considered beneficial, and that it also surpasses the number of beneficial and innoxious species combined.

The facts on the whole overwhelmingly speak in favor of the Crow, and taken alone would be at variance with the prevalent opinion hitherto held and yet held regarding the economic status of the Crow as an insectivorous bird.

How far these general conclusions may be modified by the indirect nature of the food examined, i. e., by the habit of the Crow of feeding upon toads and frogs and even small birds and other insectivorous animals, I am in no position to determine. It is probable, however, that only a small proportion of the insect food of the Crow is derived in this indirect manner and that in so far the conclusions as to its economic status are not to be modified.

A complete list of the insects contained in each one of the six hundred or more stomachs critically examined would not only make the present bulletin too bulky, but the constant repetition of names would only mislead and bewilder the reader, if indeed any enthusiast would care to read it all. It is better, therefore, to omit the detailed statement of the insect remains found in each stomach and give only the general results.

